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The Development and Implementation of a Mathematics Placement Program

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Many colleges and universities use a mathematics placement process to guide students to the appropriate entry level mathematics course. The mathematics placement process presented here was developed over a four year period to make placement recommendations to Calculus I, Precalculus, and College Algebra. Placement recommendations are based on the combination of a placement exam score and American College Testing Assessment math subscore. Specific cutoff score pairs were formed in an attempt to optimally identify the highest level courses into which students may be placed where students will be successful.

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Background

In the fall of 1995, the mathematics department at a small private college in the midwest began to use a mathematics placement exam to help determine the most appropriate entry level mathematics course for new students. The placement exam was developed from materials provided by the Placement Test Program of the Mathematical Association of America. The Math Placement Test (MPT) is a two part thirty seven item multiple choice exam. Part I of the MPT consists of twenty problems on advanced algebra. Part II of the MPT consists of seventeen questions on elementary functions and trigonometry. Students are allowed twenty five minutes on each part. The goal was to have all freshman students and all transfer students not transferring mathematics credits take the MPT prior to registering for a math course. After four years of administering the MPT, the goal was achieved with close to 100% success. The MPT determines placement for the entry–level courses College Algebra, Precalculus, and Calculus I.

The decision to use the MPT to help determine the most appropriate entry level math course resulted from the mathematics faculty's concerns about disparities in the mathematical preparation of students wishing to enroll in these courses, frequent student complaints that courses were too hard, and a high percentage of students dropping the courses.

Over the past four years, few changes were made in the the entry level curriculum and the testing administration. The MPT was administered all four years and there were no changes in the Calculus I course content or text. The Precalculus and College Algebra content remained the same but the texts were changed in the second and third years, respectively.

It is not mandatory for students to accept the mathematics placement recommendation though they are strongly encouraged to do so. Ultimately, students are free to enroll in the entry level math course of their choice. In the first two years the MPT was given, students preregistered for their mathematics courses either in the spring semester or during the summer and took the MPT later during a three day

orientation just prior to the start of the fall semester. This sequence created a situation where students had to initiate a course change if the placement advice was different from their elected math course. During the spring and summer of 1997 students who wanted to enroll in an entry level mathematics course for fall of 1997 were placed in a special registration category rather than a specific math course. Their math course was assigned in the fall of 1997 based on the results from the MPT taken at that time. This procedure required students to initiate a course change in order to disregard the placement recommendation. Beginning with the 1998–99 academic year, the college started running summer orientation weekends which replaced the previous procedure of spring preregistrations prior to the fall testing and recommendations. Taking the MPT is one of the first student orientation activities. After taking the MPT, students receive placement recommendations before they register for their courses.

Prior to using the MPT there was no rubric for mathematics placement other than placing students according to the number of years of high school math they had taken. Because of this, when the MPT was first given in 1995 the decision was made to err on the side of recommending students to start in a challenging course rather than recommending students to start in courses that were at too low a level. After looking at the distribution of scores on the MPT the following cutoffs were set.

Calculus I Cutoff Criteria

- MPT score of 18 or above, or
- MPT score from 11 through 17 and an American College Testing Assessment math score (ACT math score) of 25 or above.

Precalculus Cutoff Criteria

- MPT score from 11 through 17 and an ACT math score of 24 or below, or
- MPT score of 10 or below and an ACT math score of 22 or above.

College Algebra Cutoff Criteria

- MPT score of 10 or below and an ACT math score of 21 or below.

The consequences of placing students in entry-level math courses using these criteria were less that stellar. The math faculty felt there was still great disparity in the mathematical preparation of students in the entry-level courses. Furthermore, many students felt that their assigned courses were too difficult and the percentage of students who dropped those courses was unchanged. This result was not surprising, however, as the original aim was to err on the side of starting students in courses that were challenging rather than placing students in courses that were too easy. It became clear that the cutoff scores for the MPT needed to be refined so that students and faculty would have confidence in the placement recommendations.

Refinement of the Math Placement Standards

In order to meet the challenge of refining the placement exam cutoff scores it was necessary to have an accurate picture of student performance in the entry-level mathematics courses. It was decided to use fall 1993 as the starting point for the data analysis, based on two criteria. First, the current structure and content of College Algebra and Precalculus began in the fall of 1993, and second, prior to that time there were changes in the five-member mathematics faculty. New members joined the department in 1992 and 1993. The department also welcomed another new member in 1995.

In order to refine the MPT recommendations, the first task was to summarize student performance in entry-level courses from fall 1993 through spring 1996. First, students were assigned to three groups for each course. Group I consisted of those students who were taking the course as their first college math course. Group II consisted of those students who were taking the course for the first time. This group contained the students from group I plus those students who were in the course for the first time but who had taken some other course as their first college math course. Group III consisted of all students taking the course. This group contained the students in group II plus any students who were repeating the course.

In the summer of 1996, grade reports from the 1993 94, 1994 95, and 1995 96 academic years were collected from the registrar for the three entry level courses. The distributions of grades pooled over the three year period from fall 1993 through spring 1996 for the three groups in Calculus I, Precalculus, and College Algebra are given in Tables 1, 2, and 3, respectively. Table 1 shows that the percentage of D's, F's, and W's for each group in Calculus I fell in the range from 34% to 36%. Table 2 shows the percentage of D's, F's, and W's for each Precalculus group was in the range from 32% to 35%. Table 3 shows that the percentage of D's, F's, and W's for each College Algebra group was in the range from 48% to 49%. This confirmed the math department's concerns about the math placement procedures.

Since the college was a teaching college with a student population of less than 1,000 which allowed relatively small class sizes, the success ranges of 64% to 66% for students beginning their college mathematics studies in Calculus I and 65% to 68% for those starting in Precalculus were not acceptable. While the success rates in College Algebra were not atypical of the experience at many other colleges and universities, it was hoped that with the size of the college and its emphasis on teaching, better results would be achieved.

Grade distributions for the three groups in each of the entry level courses for the 1995 96 academic year are presented in Tables 4, 5, and 6. While there appeared to be improvement for Precalculus, the grade distributions in Calculus I and College Algebra were worse than the three year patterns.

The next step was to examine the distribution of grades versus placement exam scores in the entry level courses to see if there was any pattern of student performance that would help determine new math placement standards. Two considerations guided this effort. The first consideration was the planned continuation of the policy that student acceptance of the placement recommendation was not mandatory. The second consideration was the math faculty's desire to develop a method of mathematics placement which would gain the confidence of the entire campus community. Such a method would not place a student in Calculus I or

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Precalculus unless there was strong evidence the student would succeed in that course. With this strategy in mind, particular MPT score ranges for Calculus I and Precalculus were sought in which at least 70% to 80% of the students had received an A or B in that course, and at most 15% to 20% had received a D, F, or W. If these score ranges could be found they would indicate the highest level mathematics course for which the student would be properly prepared, and placement recommendations could be made based on them.

A chart of Calculus I grades versus MPT scores was created. A cutoff line drawn on this chart between MPT score 22 and 23 partitioned the grades with mostly A's and B's above the line and a propensity of D's, F's, and W's below. In looking for a variable that might improve the predictive power of this cutoff, ACT math scores were considered. Using a similar procedure with the grades, MPT scores, and ACT math scores for students who had taken Precalculus, the following math placement cutoff criteria were derived.

Calculus I Cutoff Criteria

- MPT score of 23 or above.

Provisional Calculus I Cutoff Criteria (students are asked to discuss their mathematical preparation with a member of the mathematics faculty)

- MPT score from 17 through 22 and an ACT math score of 28 or above.

Precalculus Cutoff Criteria

- MPT score from 17 through 22 and an ACT math score from 21 through 27, or
- MPT score from 13 through 16 and an ACT math score of 21 or above, or
- MPT score from 13 through 22 and no ACT math score.

Provisional Precalculus Cutoff Criteria (students are asked to discuss their mathematical preparation with a member of the mathematics faculty)

- MPT score from 9 through 12 and an ACT math score of 25 or above.

College Algebra Cutoff Criteria

- ACT math score of 20 or below, or
- MPT score from 9 through 12 and an ACT math score from 21 through 24, or
- MPT score of 8 or below and an ACT math score of 21 or above, or
- MPT score of 12 or below and no ACT math score.

Tables 7, 8, and 9 show the grade distributions during the 1995–96 academic year in Calculus I, Precalculus, and College Algebra, respectively, for students who would have been recommended or provisionally recommended to Calculus I, recommended or provisionally recommended to Precalculus, or recommended to College Algebra according to the math placement cutoffs described above. The actual placement recommendations for these students during the 1995–96 academic year were made using the original math placement cutoffs. Tables 7, 8, and 9 show the grade distributions of these students in the entry–level math courses as if their math placement recommendations had been made using the newly refined math placement cutoffs. These tables, in fact, served as the basis for the establishment of these refined math placement cutoffs.

Table 7 shows that 79% of the students in Calculus I who would have been recommended to Calculus I received an A or B and only about 16% of these students received a D, F, or W. Furthermore, nearly 61% of the students in Calculus I who would have been recommended or provisionally recommended to Precalculus or recommended to College Algebra received a D, F, or W while only about 13% of them finished Calculus I with an A or B.

Table 8 shows that roughly 70% of the Precalculus students who would have been recommended to that course received an A or B, while only about 9% of

them received a D, F, or W. Further, 50% of the students in Precalculus who would have been recommended to College Algebra received a C in the course. It seemed plausible that many of these C students in Precalculus would be A or B students in College Algebra and subsequently would be A or B students in Precalculus.

It was recognized that the sample sizes on which new placement cutoffs were based were small but the situation was serious enough to warrant acting on the available data. In August 1996, the new placement exam cutoffs were approved by the mathematics department which was committed to continue to evaluate student performance in entry level courses on an annual basis.

Preliminary Results

As of July 1999, four years of administering the MPT and three years of placement recommendations based upon the method described above had passed. During this time, data on student performance in entry level math courses, MPT scores, and ACT math scores were collected. Below are the preliminary results from the analysis of this data.

The first thing considered was whether there appeared to be any long term predictive validity in the refined placement cutoffs which were created from relatively small samples in 1996. This can be answered generally in the affirmative. Tables 10, 11, and 12 show the performance in Calculus I, Precalculus, and College Algebra, respectively, of students who were recommended or provisionally recommended to take Calculus I, recommended or provisionally recommended to take Precalculus, or recommended to take College Algebra. Included in this analysis are the students represented in Tables 7, 8, and 9. As was noted previously, the actual placement recommendations for these students were made using the original placement cutoffs rather than the revised cutoffs for which the predictive validity is being analyzed. Tables 7, 8, and 9 show the grade distributions of these students in the entry level math courses as if their math placement recommendations had been made using the newly refined math placement cutoffs. The inclusion of these students in the analysis is important for answering questions related to how students in the placement

categories defined by the revised placement cutoffs have performed in all the entry-level math courses.

As Table 10 shows, over the four years when placement data was collected, only about 17% of the Calculus I students whose MPT scores placed them into Calculus I received a D, F, or W, while just over 66% of these students received an A or B. Furthermore, only one student out of 65, a scant 1.54%, ended up dropping the course.

As for the students in Calculus I whose scores placed them into Precalculus, provisionally into Precalculus, or into College Algebra, the D's, F's, and W's constituted 47.5%, with the W's at 17.5%.

Table 11 reveals that for students in Precalculus whose scores placed them in that course, fewer than 11% received a D, F, or W. The W's constituted only 3.4% of the students while nearly 71% received an A or B.

Of the Precalculus students whose scores placed them in College Algebra, roughly 38% received a D, F, or W; 21% dropped the course and received a W.

In College Algebra, immediate results from the efforts to improve mathematics placement were not seen. Table 12 gives grade distributions for College Algebra during each of the four academic years from fall 1995 through spring 1999. During the 1995-96 and 1996-97 academic years, College Algebra continued to be plagued by very high percentages of D's, F's, and W's; combined percentages for D's, F's, and W's were 56% and 62%, respectively. In each of these academic years, more than one-third of the students taking College Algebra ended up dropping the course and receiving a W.

The academic years of 1997-98 and 1998-99 saw a significant change from this trend. The combined D-F-W percentages from these years of 36% and 27%, respectively, were at or below the level for W's alone in each of the two previous years. Even more noteworthy was the decline in the percentages of W's from 33% and 36% in 1995-96 and 1996-97 to 6% and 3.5% in 1997-98 and 1998-99, respectively.

Three factors were identified that were believed to contribute to this change.

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One factor was the previously mentioned change in preregistration procedures which led to a decrease in the percentage of students who took their first college math course at a level higher than what was recommended. Table 13 shows that the percentage of students taking Calculus I as their first college math course who were recommended or provisionally recommended to Precalculus or recommended to College Algebra has declined steadily from 41% in 1995 96 to 6% in 1998 99. Table 13 reveals a similar trend among students taking Precalculus as their first college math course who were recommended to College Algebra, with the percentage dropping from 47% in 1995 96 to 7% in 1998 99. The percentages for 1995 96 are based on the data from Tables 7, 8, and 9. They should be interpreted as indicating that if the revised placement standards for which the predicitive validity is being examined had been used at that time to make placement recommendations then 41% of the students taking Calculus I as their first college math course would have been recommended or provisionally recommended to Precalculus or recommended to College Algebra and 47% of the students taking Precalculus as their first college math course would have been recommended to College Algebra.

Two non placement efforts to help improve the success rates of the less well prepared students in College Algebra were also implemented. One effort was a significant expansion of the drop in peer tutoring program from eight hours per week in the evenings to twenty two hours per week in the afternoons, evenings, and on weekends. The second effort was a change to a math reform style text which approached College Algebra through an emphasis on applications. This text was well received by the students in this course.

The stated goal for the placement cutoffs was that for students whose scores placed them into Precalculus, 70% to 80% would receive an A or B and at most 15% to 20% would receive a D, F, or W. As the preceding data analysis indicates, this goal was achieved and maintained successfully through the 1998 99 academic year. In Calculus I the same goal was met and maintained through the 1998 99 academic year with a high degree of success. The D F W percentage of 17.5% over four years

among Calculus I students whose placement scores placed them into Calculus I was within the desired parameters while the A–B percentage of 66% over four years fell just short of the desired 70% to 80%. Further, 47.5% of the Calculus I students whose scores placed them into Precalculus, provisionally into Precalculus, or into College Algebra received a D, F, or W in Calculus I. Of the Precalculus students whose scores placed them into College Algebra 38% received a D, F, or W.

Based on these results a good start had been made at discriminating between students who were likely to be successful in Calculus I, Precalculus, and College Algebra and those who were not. The next challenge was to further refine the cutoffs to further improve on results.

The question was raised whether there was evidence to indicate a benefit for students to follow placement advice to start in a math course that was at a lower level than their original intent. Specifically, will following placement advice result in improved performance in higher level courses once students eventually complete them? Once again it was reasonable to believe that the answer was "yes".

Table 14 presents a breakdown of grade distributions for Calculus I from fall 1995 through spring 1999. Distributions are given for students who were recommended or provisionally recommended to take Precalculus or recommended to take College Algebra but who took Calculus I as their first college math course and students who were recommended or provisionally recommended to Precalculus or recommended to College Algebra and who completed the Precalculus/Calculus I sequence, with Precalculus taken only once.

As Table 14 shows, of the students who were recommended or provisionally recommended to take Precalculus or recommended to take College Algebra but who took Calculus I as their first college math course, about 48% received a D, F, or W while about 28% received an A or B. Among those who started in a lower level math course and then took Calculus I, the D–F–W percentage was just under 30%. This was an improvement of nearly 18 percentage points.

The improvement is clarified even more, however, if the students who were

recommended or provisionally recommended to take Precalculus and those who were recommended to take College Algebra are considered separately. There was a significant difference in the Calculus I performance of the students who were recommended or provisionally recommended to take Precalculus who actually took Precalculus or College Algebra as their first college math course versus those who were recommended to take College Algebra who actually took Precalculus or College Algebra as their first college math course. Table 15 gives the Calculus I grade distributions for students recommended to take College Algebra. Table 16 provides the Calculus I grade distributions for students who were recommended to take Precalculus.

As Table 15 shows, among the students who were recommended to take College Algebra the overall performance in Calculus I was rather poor whether placement advice was followed or not. It is worth noting that very few students who were recommended to College Algebra opted to start in Calculus I as their first college math course.

In contrast to the poor performance of Calculus I students who were recommended to College Algebra, Table 16 reveals that the Calculus I performance among students who were recommended or provisionally recommended to Precalculus who actually took Precalculus or College Algebra as their first college math course was quite good. The combined percentage of D's, F's, and W's for these students was only 18% while 41% of them received an A or B. This also represents a significant improvement over the Calculus I performance of students who were recommended or provisionally recommended to Precalculus but who went directly into Calculus I. Table 16 shows that 47% of these students received a D, F, or W while only 28% received an A or B. Thus, there was roughly a 29 percentage point decrease in the percentage of D's, F's, and W's and about a 13 percentage point increase in the percentage of A's and B's for students who followed the placement advice versus those who did not.

A similar comparison can be made among the students in Precalculus who

were recommended to College Algebra. In Table 17 a comparison of Precalculus grade distributions from fall 1995 through spring 1999 is made between those who went directly into Precalculus and those who completed the College Algebra/Precalculus sequence. Among the students taking Precalculus as their first college math course 38% received a D, F, or W while the D–F–W percentage for students taking College Algebra first was 24%. A very dramatic change was seen in the percentage of W's, from 21% of those going directly into Precalculus to 7% among the students completing the College Algebra/Precalculus sequence. The percentage of A's and B's among students going directly into Precalculus was 22% whereas 34% of those taking College Algebra before Precalculus received an A or B in Precalculus.

As in the comparisons involving students in Calculus I, it is useful to partition the set of Precalculus students with ACT math scores into the following subsets: those with an ACT math score of 21 or above and those with an ACT math score of 20 or below. Note that four of the eighty–nine students included in Table 17 who went directly into Precalculus did not have an ACT math score so they do not fall into either subset. Table 18 presents the grade distributions in Precalculus for students who were recommended to take College Algebra with an ACT math score of 21 or above but who went directly into Precalculus and students who were recommended to take College Algebra with an ACT math score of 21 or above who completed the College Algebra/Precalculus sequence, with College Algebra taken only once. Table 19 presents the grade distributions in Precalculus for students who were recommended to take College Algebra with an ACT math score of 20 or below but who went directly into Precalculus and students who were recommended to take College Algebra with an ACT math score of 20 or below who completed the College Algebra/Precalculus sequence, with College Algebra taken only once.

As can be seen in Table 18, the combined D–F–W percentage for students with an ACT math score of 21 or above who went direcly into Precalculus was about 27%, whereas the percentage of students completing the College Algebra/Precalculus sequence who received a D, F, or W in precalculus was only about 13%. Only about

3% of the students completing the College Algebra/Precalculus sequence ended up dropping Precalculus and receiving a W, compared to nearly 9% of the students who went directly into Precalculus. The A–B percentage among students going directly into Precalculus was roughly 33%, with the A's totaling only 2%. Among the students who completed the College Algebra/Precalculus sequence, 43% received an A or B, with 18% of them receiving an A.

Table 19 reveals that among the students recommended to take College Algebra with an ACT math score of 20 or below about 59% of the students who went directly into Precalculus ended up with a D, F, or W, with 35% of them dropping the course. The combined D–F–W percentage for students who took College Algebra first matched this 35%, and only 10% of these students received a W. The combined percentage of A's and B's for students going directly into Precalculus was about 13% while 27% of the students who took College Algebra before taking Precalculus received an A or B in Precalculus.

In both subsets there were significant improvements in the combined D–F–W percentages, the percentages of W's, and the combined A–B percentages in Precalculus among the students who took College Algebra as their first college math course over those who went directly into Precalculus. Note also that the overall Precalculus grade distributions were significantly better for students with an ACT math score of 21 or above than for students with an ACT math score of 20 or below, both for students going directly into Precalculus and those taking College Algebra first.

It was not conclusively determined that students who followed the placement advice and then subsequently took a higher level math course did better in that higher level course than they would have if they had taken the higher level course directly. However, the data presented here gives reason to believe that this is likely. Regardless, the significant improvement in the Calculus I grade distribution of students who completed the Precalculus/Calculus I sequence over the grade distribution of those who entered directly into Calculus I supports the

Precalculus/Calculus I placement cutoff. Further, the significant improvement in the Precalculus grade distribution of students taking the College Algebra/Precalculus sequence over the grade distribution of those who entered directly into Precalculus supports the College Algebra/Precalculus cutoff.

The effects of implementing new placement cutoffs on the overall performance of students in the three entry-level math courses was considered by examining grades of three related groups of students for each entry-level math course. These groups consisted of students taking the course as their first college math course, students taking the course for the first time, and all students taking the course. The grade distributions in these categories are compared for the period since the math department began using the new placement cutoffs (fall 1996 through spring 1999) and the period prior to their implementation (fall 1993 through spring 1996). Tables 1, 2, and 3 present the grade distributions in the three categories, pooled over the period from fall 1993 through spring 1996, for Calculus I, Precalculus, and College Algebra, respectively. The pooled grade distributions over the three year period from fall 1996 through spring 1999 for the three groups in Calculus I, Precalculus, and College Algebra, are given in Tables 20, 21, and 22, respectively.

A comparison of the data presented in Table 1 to that presented in Table 20 shows that among students taking Calculus I as their first college math course the combined percentage of D's, F's, and W's declined from 34% for the three-year period before the new placement cutoffs were implemented to 23% during the three years after their introduction. The W's declined even more significantly, from 17% to 5%. There was also an increase in the combined percentage of A's and B's, from a total of 44% for the period from fall 1993 through spring 1996 to 54% for the period from fall 1996 through spring 1999.

Among students taking Calculus I for the first time there was a decline in the combined D F W percentage from 36% for the three years prior to the implementation of the new placement cutoffs to 25% for the three subsequent years. The decline in the percentage of W's was roughly six percentage points, from about

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17% for the period from fall 1993 through spring 1996 to about 11% from fall 1996 through spring 1999. The combined A–B percentage rose from about 39% to about 45%.

The category of all students taking Calculus I contains the students from the two previously considered categories plus the students who repeated the course. The changes in combined percentage of D's, F's, and W's, percentage of W's, and combined percentage of A's and B's were roughly the same as for students taking Calculus I for the first time.

A comparison of Tables 1 and 20 also provides evidence of a significant shift in enrollment patterns in Calculus I. The total number of students taking Calculus I declined from 276 for the first three year period to 180 for the second, representing a drop of 35% or about 32 students per year on average.

Another shift in the enrollment pattern that was observed was a change in the time at which students took Calculus I. Out of a total of 251 students who took Calculus I for the first time from fall 1993 through spring 1996, 198 of them, or about 79%, took it as their first college math course. From fall 1996 through spring 1999 there were 80 students taking Calculus I as their first college math course among the 161 first time students in the course. Thus, in the latter period only 50% of the students taking Calculus I for the first time began their college mathematics studies in Calculus I. Of those who didn't, all but a handful took Precalculus or College Algebra as their first college math course.

A comparison in Precalculus over the two time periods shows many significant changes in the grade distributions for the three categories in this course as well. Comparing the data from Tables 2 and 21 shows that there was a substantial decline in the combined percentage of D's, F's, and W's for students taking Precalculus as their first college math course, from 32% in the period from fall 1993 through spring 1996 to 17% for the period from fall 1996 through spring 1999. The percentage of W's declined only slightly, from about 12% in the first three year period to about 8% in the second three year period. The percentage of A's and B's nearly doubled from

about 32% prior to the introduction of the new placement cutoffs to about 62% after their implementation.

Among the students taking Precalculus for the first time 32% received a D, F, or W before the new placement cutoffs were put in place while the D's, F's, and W's made up 23% of the grades afterward. The change in the percentage of W's was not significant, declining from about 12% during the period from fall 1993 through spring 1996 to about 9% for the period from fall 1996 through spring 1999. The percentage of students receiving an A or B rose sharply, from about 30% during the first three year period to about 50% during the second three year period.

The changes in the combined percentage of D's, F's, and W's, and combined percentage of A's and B's for the category of all students taking Precalculus mirrored those for the category of students taking Precalculus for the first time.

The overall enrollments in Precalculus did not decline as precipitously as those in Calculus I. The drop from 511 students taking Precalculus in the first three year period to 454 in the second is a percentage decrease of 11%, or about 19 students per year. The percentage of first time students in Precalculus who took it as their first college math course decreased from 74% during the period from fall 1993 through spring 1996 to 57% from fall 1996 through spring 1999. As with Calculus I, during the last three years a significantly greater portion of the students who took Precalculus for the first time began their college math studies at a level of mathematics lower than Precalulus than was the case for the three years from fall 1993 through spring 1996.

Tables 3 and 22 provide the grade distributions for comparing student performances in College Algebra. Among the students taking College Algebra as their first college math course the combined percentage of D's, F's, and W's dropped from about 49% for the period from fall 1993 through spring 1996 to roughly 40% for the period from fall 1996 through spring 1999. The percentage of W's declined from 24% prior to the implementation of the new placement cutoffs to 14% after their introduction. The combined percentage of A's and B's rose sharply, from about 17%

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to about 33%.

Among students taking College Algebra for the first time about 48% received a D, F, or W from fall 1993 through spring 1996. This dropped to about 40% from fall 1996 through spring 1999. The percentage of W's declined from about 22% to 14%, and the combined A B percentage rose from 18% to 32%.

The changes in the combined percentage of D's, F's, and W's, the percentage of W's and the percentage of A's and B's for the category of all students taking College Algebra mirrored those for the category of students taking College Algebra for the first time.

The total enrollments in College Algebra increased dramatically during the last three years. From fall 1993 through spring 1996 a total of 288 students took College Algebra. This figure rose to 430 students from fall 1996 through spring 1999. This represents a percentage increase of 50%, or about 47 students per year. As was to be expected with the lowest entry level math offering, almost all of the first time students in College Algebra took the course as their first college math course.

As noted above, the progress seen in College Algebra did not begin immediately following the implementation of the new placement cutoffs. The last two academic years, 1997 98 and 1998 99, have seen a dramatic improvement in student performance in College Algebra over that from 1996 97. As evidence of this significant shift, the College Algebra grade distributions in each of these three academic years for the three categories considered above are provided in Tables 23, 24, and 25.

As presented above, the evaluation of the mathematics placement process puts considerable emphasis on the grade distributions in the entry level mathematics courses. The validity of this approach is supported by a comparison of the performance of students in the second course of a two course sequence versus their performance in the first course of the sequence. Table 26 makes this comparison for the Precalculus/Calculus I and College Algebra/Precalculus sequences, from fall 1993 through spring 1999. The evidence presented in this table provides reason to believe that a higher grade in the prerequisite course of a two course sequence indicates a

greater likelihood of success in the subsequent course.

Of 40 Calculus I students who received an A in Precalculus only 2 of them, or 5%, received a D, F, or W in Calculus I. A total of 28 of these students, or 70%, received an A or B in Calculus I. Among the 41 Calculus I students who had earned a B in Precalculus, there were 14, or about 34%, who received a D, F, or W in Calculus I. Only 5 of these students, or about 12%, earned an A or B in Calculus I. Of the 24 Calculus I students whose Precalculus grade was a C there were 19, or 79%, who finished Calculus I with a D, F, or W. None of these students received an A or B in Calculus I.

There were 18 Precalculus students whose College Algebra grade was an A and only one of them, or about 6%, received a D, F, or W in Precalculus. A total of 15, or about 83%, of the A students in College Algebra earned an A or B in Precalculus. A total of 50 students who received a B in College Algebra went on to Precalculus and 12 of them, or 24%, ended up with a D, F, or W in Precalculus. There were 13 of these students, or 26%, whose Precalculus grade was an A or B. Among the Precalculus students who had earned a C in College Algebra 20 of 59, or 34%, received a D, F, or W in Precalculus. Only 9 of these students, or 15%, earned an A or B in Precalculus.

Further Refinement of the Math Placement Standards

The goal of the mathematics placement process is to place students into the highest level math course for which they are prepared. The data analysis presented above indicates that students who follow the placement recommendation based on the placement cutoffs outlined earlier have a high degree of success in their mathematics courses. In an effort to improve upon this success, the mathematics faculty made the following incremental changes to the placement cutoffs. These adjustments were put into place during the summer orientations in 1999.

1. Students with an MPT score of 21 or 22 and an ACT math score of 28 or above will receive a recommendation to take Calculus I rather than a provisional recommendation to take Calculus I. Table 27 examines the performance of three

subsets of this group of students from fall 1995 through spring 1999. It gives the Precalculus grade distribution of the students who took Precalculus as their first college math course, the Calculus I grade distribution of the students who completed the Precalculus/Calculus I sequence, and the Calculus I grade distribution for students who took Calculus I as their first college math course. Although all of these subsets are very small in size, the extremely high rate of success shown for each subset gives reason to believe that these students are properly prepared to enter directly into Calculus I.

2. Students with an MPT score of 21 or 22 and an ACT math score from 21 through 27 will receive a provisional recommendation to take Calculus I rather than a recommendation to take Precalculus. Table 28 presents the performance of the three subsets for this group as does Table 27 for the group of students with an MPT score of 21 or 22 and an ACT math score of 28 or above. None of the students who took Precalculus as their first college math course received a D, F, or W in Precalculus, and none of those who went on to Calculus I received a D, F, or W in Calculus I. However, a third of the students who took Calculus I as their first college math course received a D, F, or W in Calculus I, while the other two thirds received an A or B. Given the high rate of success of the students who started in Precalculus and the mixed results for those who started in Calculus I it is appropriate to give these students a provisional recommendation to Calculus I, with the request that they discuss their mathematical preparation with a member of the mathematics faculty.

3. Students with an MPT score from 9 through 12 and an ACT math score of 25 or above will receive a recommendation to take Precalculus rather than a provisional recommendation to take Precalculus. The performance of three subsets of this group of students, from fall 1995 through spring 1999, are given in Table 29. It presents the College Algebra grade distribution of those students who took College Algebra as their first college math course, the Precalculus grade distribution of the students who completed the College Algebra/Precalculus

sequence, and the Precalculus grade distribution of students for whom Precalculus was their first college math course. Since only one out of 20 students who took Precalculus as their first college math course received a D, F, or W and 17 of 20, or 85%, received an A or B, it appears that these students are properly prepared for the Precalculus course.

4. Students with an MPT score of 11 or 12 and an ACT math score from 21 through 24 will receive a provisional recommendation to take Precalculus rather than a recommendation to take College Algebra. Table 30 presents the performance of the three subsets for this group as does table 29 for the group of students with an MPT score from 9 through 12 and an ACT math score of 25 or above. Of the students who took College Algebra as their first college math course, 15% received a D, F, or W while 65% received an A or B. Of those who started in College Algebra and went on to Precalculus, 20% received a D, F, or W in Precalculus while 30% received an A or B. Among the students who went directly into Precalculus, 27% had a D, F, or W in Precalculus and 20% had an A or B. Thus, these students have a high rate of success in College Algebra. For those who took Precalculus, their performance is somewhat better if they took Precalculus first rather than if they went directly into Precalculus.

Four other adjustments were made to the math placement cutoffs, all of which involve students with a relatively high MPT score and a relatively low ACT math score or vice-versa. There were only a handful of such students over the last four years so no data is presented to support these changes. The decision to make these adjustments was based on the experience gained over the last four years.

5. Students with an MPT score of 23 or above and an ACT math score of 20 or below will receive a provisional recommendation to take Calculus I.

6. Students with an MPT score of 21 or 22 and an ACT math score of 20 or below will receive a recommendation to take Precalculus.

7. Students with an MPT score from 17 through 20 and an ACT math score of 20 or below will receive a provisional recommendation to take Precalculus.

8. Students with an MPT score of 8 or below and an ACT math score of 27 or above will receive a provisional recommendation to take Precalculus.

The further refined MPT cutoff scores are presented below. They were used to determine mathematics placement recommendations for the first time in the summer of 1999.

Calculus I Cutoff Criteria

- MPT score of 23 or above, or
- MPT score of 21 or 22 and an ACT math score of 28 or above.

Provisional Calculus I Cutoff Criteria

- MPT score of 21 or 22 and an ACT math score from 21 through 27, or
- MPT score from 17 through 20 and an ACT math score of 28 or above, or
- MPT score of 23 or above and an ACT math score of 20 or below.

Precalculus Cutoff Criteria

- MPT score from 17 through 20 and an ACT math score from 21 through 27, or
- MPT score from 13 through 16 and an ACT math score of 21 or above, or
- MPT score from 9 through 12 and an ACT math score of 25 or above, or
- MPT score from 13 through 22 and no ACT math score.

Provisional Precalculus Cutoff Criteria

- MPT score of 11 or 12 and an ACT math score from 21 through 24, or
- MPT score of 8 or below and an ACT math score of 27 or above, or

- MPT score from 17 through 20 and an ACT math score of 20 or below.

College Algebra Cutoff Criteria

- MPT score of 9 or 10 and an ACT math score from 21 through 24, or
- MPT score of 8 or below and an ACT math score from 21 through 26, or
- MPT score of 16 or below and an ACT math score of 20 or below, or
- MPT score of 12 or below and no ACT math score.

Tables 27, 28, 29, and 30 provide evidence that supports these refined math placement cutoffs. When listed in this form, the mathematics placement cutoffs may seem to be a confusing welter of categories with which to work. However, the mathematics faculty was able to represent the placement cutoffs on a color coded grid that makes finding the appropriate math placement recommendations a very simple matter. The grid is presented as Table 31, in a black and white format.

Summary And Conclusion

In the fall of 1995, the mathematics department at a small private college in the midwest began to use a mathematics placement exam to help determine the most appropriate entry level mathematics course for new students. The entry level math courses under consideration were Calculus I, Precalculus, and College Algebra. There was no prior rubric for determining mathematics placement other than placing students according to the number of years of high school math they had taken. Because of this, during the initial implementation of math placement recommendations based on the math placement exam a decision was made to err on the side of recommending students to start in a challenging course rather than in a course that was at too low a level. Initial math placement cutoff criteria were set in accordance with this decision.

The consequence of this decision was that little changed in student performance in the entry level math courses during the academic year after the first administration of

the math placement exam. The math faculty felt there was still great disparity in the mathematical preparation of students in the entry level mathematics courses, many students felt that their assigned courses were too difficult, and the relatively high percentage of students dropping those courses remained the same.

During the summer of 1996 the math placement cutoff criteria were refined using a procedure that compared data on student performance in entry level math courses, student scores on the math placement exam, and student ACT math scores. This type of data was evaluated on an annual basis through the end of the 1998–99 academic year. The data provides evidence that the refined math placement cutoff criteria devised in the summer of 1996 have a very high level of long–term predictive validity. The data also provides evidence to support the conclusion that there is a benefit for students to follow placement advice to start in a math course that was at a lower level than their original intent. There is also evidence of a significant improvement of grade distributions in the entry–level math courses in the three year period since the refined placement cutoff criteria were first implemented (fall 1996–spring 1999) versus the three year period prior to their implementation (fall 1993–spring 1996). Finally, there is evidence of a significant change in student enrollment patterns in the entry level math courses as a result of the implementation of the refined math placement cutoff criteria.

Based on these results the mathematics faculty feels that a good start has been made at discriminating between students who are likely to be successful in Calculus I, Precalculus, and College Algebra and those who are not. The data indicates that students who follow the placement recommendations based on the refined math placement cutoff criteria have a high degree of success in their mathematics courses. In an effort to improve upon this success, during the summer of 1999 the mathematics faculty made and implemented several further incremental refinements to the previously refined placment cutoff criteria.

TABLE 1

Grade Distributions Over Fall 1993–Spring 1996 For Calculus I For Groups I, II, and III

Group I: Grade Distribution of Students Taking Calculus I as Their First College Math Course
Total: 198

Grade:	A	B	C	D	F	W
Number:	42	45	44	23	11	33
%:	21.21	22.73	22.22	11.62	5.55	16.67

Group II: Grade Distribution of Students Taking Calculus I for the First Time
Total: 251

Grade:	A	B	C	D	F	W
Number:	45	54	61	31	16	44
%:	17.93	21.51	24.3	12.35	6.38	17.53

Group III: Grade Distribution of All Students Taking Calculus I
Total: 276

Grade:	A	B	C	D	F	W
Number:	47	60	74	33	17	45
%:	17.03	21.74	26.81	11.96	6.16	16.3

TABLE 2

Grade Distributions Over Fall 1993–Spring 1996 For Precalculus For Groups I, II, and III

Group I: Grade Distribution of Students Taking Precalculus as Their First College Math Course
Total: 320

Grade:	A	B	C	D	F	W
Number:	45	58	114	23	19	37
%:	14.06	18.13	35.66	14.69	5.9	11.56

Group II: Grade Distribution of Students Taking Precalculus for the First Time
Total: 431

Grade:	A	B	C	D	F	W
Number:	54	74	164	62	25	52
%:	12.53	17.17	38.05	14.39	5.8	12.06

Group III: Grade Distribution of All Students Taking Precalculus
Total: 511

Grade:	A	B	C	D	F	W
Number:	54	77	201	82	35	62
%:	10.58	15.06	39.33	16.05	6.85	12.13

TABLE 3

Grade Distributions Over Fall 1993–Spring 1996 For College Algebra For Groups I, II, and III

Group I: Grade Distribution of Students Taking College Algebra as Their First College Math Course
Total: 240

Grade:	A	B	C	D	F	W
Number:	10	32	80	34	26	58
%:	4.17	13.33	33.33	14.17	10.83	24.17

Group II: Grade Distribution of Students Taking College Algebra for the First Time
Total: 262

Grade:	A	B	C	D	F	W
Number:	11	37	89	38	28	59
%:	4.2	14.12	33.97	14.5	10.69	22.52

Group III: Grade Distribution of All Students Taking College Algebra
Total: 288

Grade:	A	B	C	D	F	W
Number:	11	38	98	41	36	64
%:	3.82	13.19	34.03	14.24	12.5	22.22

TABLE 4

Grade Distributions Over the 1995–96 Academic Year For Calculus I For Groups I, II, and III

Group I: Grade Distribution of Students Taking Calculus I as Their First College Math Course
Total: 56

Grade:	A	B	C	D	F	W
Number:	11	14	9	8	4	10
%:	19.64	25	16.07	14.29	7.14	17.86

Group II: Grade Distribution of Students Taking Calculus I for the First Time
Total: 70

Grade:	A	B	C	D	F	W
Number:	12	17	13	9	4	15
%:	17.14	24.29	18.57	12.86	5.71	21.43

Group III: Grade Distribution of All Students Taking Calculus I
Total: 82

Grade:	A	B	C	D	F	W
Number:	14	21	16	11	4	16
%:	17.07	25.6	19.51	13.41	4.9	19.51

TABLE 5

Grade Distributions Over the 1995–96 Academic Year For Precalculus For Groups I, II, and III

Group I: Grade Distribution of Students Taking Precalculus as Their First College Math Course
Total: 93

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	15	15	40	8	3	12
%:	16.13	16.13	43.01	8.6	3.23	12.9

Group II: Grade Distribution of Students Taking Precalculus for the First Time
Total: 138

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	19	23	60	13	5	18
%:	13.78	16.67	43.97	9.42	3.62	13.04

Group III: Grade Distribution of All Students Taking Precalculus
Total: 164

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	19	23	75	18	10	19
%:	11.58	14.02	45.73	10.98	6.11	11.58

TABLE 6

Grade Distributions Over the 1995–96 Academic Year For College Algebra For Groups I, II, and III

Group I: Grade Distribution of Students Taking College Algebra as Their First College Math Course
Total: 84

Grade:	A	B	C	D	F	W
Number:	4	7	29	6	10	28
%:	4.76	8.33	34.52	7.14	11.9	33.33

Group II: Grade Distribution of Students Taking College Algebra for the First Time
Total: 88

Grade:	A	B	C	D	F	W
Number:	4	7	32	6	10	29
%:	4.57	7.95	36.36	6.81	11.36	32.95

Group III: Grade Distribution of All Students Taking College Algebra
Total: 102

Grade:	A	B	C	D	F	W
Number:	4	8	36	9	15	30
%:	3.93	7.84	35.29	8.82	14.71	29.41

TABLE 7

A Priori Grade Distributions Over the 1995–96 Academic Year For Calculus I, According to the Revised Placement Cutoff Criteria

Grade Distribution of Calculus I Students Who Would Have Been Recommended to Calculus I
Total: 19

Grade:	A	B	C	D	F	W
Number:	6	9	1	2	1	0
%:	31.58	47.37	5.26	10.53	5.26	0

Grade Distribution of Calculus I Students Who Would Have Been Provisionally Recommended to Calculus I
Total: 6

Grade:	A	B	C	D	F	W
Number:	1	2	1	0	0	2
%:	16.7	33.3	16.7	0	0	33.3

Grade Distribution of Calculus I Students Who Would Have Been Recommended or Provisionally Recommended to Precalculus or Recommended to College Algebra
Total: 23

Grade:	A	B	C	D	F	W
Number:	2	1	6	6	3	5
%:	8.7	4.34	26.09	26.09	13.04	21.74

TABLE 8

A Priori Grade Distributions Over the 1995–96 Academic Year For Precalculus, According to the Revised Placement Cutoff Criteria

Grade Distribution of Precalculus Students Who Would Have Been Provisionally Recommended to Calculus I
Total: 0

Grade Distribution of Precalculus Students Who Would Have Been Recommended to Precalculus
Total: 23

Grade:	A	B	C	D	F	W
Number:	7	9	5	0	0	2
%:	30.43	39.13	21.72	0	0	8.72

Grade Distribution of Precalculus Students Who Would Have Been Provisionally Recommended to Precalculus
Total: 5

Grade:	A	B	C	D	F	W
Number:	1	1	2	0	0	1
%:	20	20	40	0	0	20

Grade Distribution of Precalculus Students Who Would Have Been Recommended to College Algebra
Total: 44

Grade:	A	B	C	D	F	W
Number:	2	4	22	6	2	8
%:	4.55	9.09	50	13.63	4.55	18.18

TABLE 9

A Priori Grade Distribution Over the 1995–96 Academic Year For College Algebra, According to the Revised Placement Cutoff Criteria

Grade Distribution of College Algebra Students Who Would Have Been Recommended to College Algebra
Total: 68

Grade:	A	B	C	D	F	W
Number:	1	5	24	6	9	23
%:	1.48	7.35	35.29	8.82	13.24	33.82

TABLE 10

Grade Distributions Over Fall 1995–Spring 1999 For Calculus I

Grade Distribution of Students Who Were Recommended to Calculus I
Total: 65

Grade:	A	B	C	D	F	W
Number:	21	22	11	7	3	1
%:	32.3	33.85	16.92	10.77	4.62	1.54

Grade Distribution of Calculus I Students Who Were Provisionally Recommended to Calculus I
Total: 19

Grade:	A	B	C	D	F	W
Number:	5	4	3	2	2	3
%:	26.32	21.05	15.79	10.52	10.52	15.79

Grade Distribution of Calculus I Students Who Were Recommended or Provisionally Recommended to Precalculus or Recommended to College Algebra
Total: 40

Grade:	A	B	C	D	F	W
Number:	6	5	10	8	4	7
%:	15	12.5	25	20	10	17.5

TABLE 11

Grade Distributions Over Fall 1995–Spring 1999 For Precalculus

Grade Distribution of Precalculus Students Who Were Provisionally Recommended to Calculus I
Total: 19

Grade:	A	B	C	D	F	W
Number:	11	6	1	0	0	1
%:	57.9	31.58	5.26	0	0	5.26

Grade Distribution of Precalculus Students Who Were Recommended to Precalculus
Total: 147

Grade:	A	B	C	D	F	W
Number:	51	53	28	8	2	5
%:	34.69	36.05	19.05	5.42	1.37	3.4

Grade Distribution of Precalculus Students Who Were Provisionally Recommended to Precalculus
Total: 21

Grade:	A	B	C	D	F	W
Number:	6	11	3	0	0	1
%:	28.57	52.38	14.29	0	0	4.76

Grade Distribution of Precalculus Students Who Were Recommended to College Algebra
Total: 89

Grade:	A	B	C	D	F	W
Number:	3	17	35	11	4	19
%:	3.36	19.1	39.33	12.36	4.5	21.35

TABLE 12

Grade Distributions Over the 1995–96, 1996–97, 1997–98, and 1998–99 Academic Years and Over Fall 1995–Spring 1999 For College Algebra Students Who Were Recommended to College Algebra

Grade Distribution Over the 1995–96 Academic Year For College Algebra Students Who Were Recommended to College Algebra
Total: 68

Grade:	A	B	C	D	F	W
Number:	1	5	24	6	9	23
%:	1.48	7.35	35.29	8.82	13.24	33.82

Grade Distribution Over the 1996–97 Academic Year For College Algebra Students Who Were Recommended to College Algebra
Total: 90

Grade:	A	B	C	D	F	W
Number:	6	9	19	14	9	33
%:	6.64	10	21.11	15.56	10	36.67

Grade Distribution Over the 1997–98 Academic Year For College Algebra Students Who Were Recommended to College Algebra
Total: 117

Grade:	A	B	C	D	F	W
Number:	14	31	30	16	19	7
%:	11.97	26.5	25.64	13.66	16.24	5.99

Grade Distribution Over the 1998–99 Academic Year For College Algebra Students Who Were Recommended to College Algebra
Total: 112

Grade:	A	B	C	D	F	W
Number:	14	27	41	18	8	4
%:	12.5	24.11	36.61	16.07	7.14	3.37

Grade Distribution Over Fall 1995–Spring 1999 For College Algebra Students Who Were Recommended to College Algebra
Total: 385

Grade:	A	B	C	D	F	W
Number:	36	71	114	54	45	65
%:	9.35	18.44	29.61	14.03	11.69	16.88

TABLE 13

Annual Percentages of Students Who Took Their First College Math Course at a Level Higher Than Recommended

Percentage of Students Taking Calculus I as Their First College Math Course Who Were Recommended or Provisionally Recommended to Precalculus or Recommended to College Algebra

1995–96	41%
1996–97	36%
1997–98	25%
1998–99	6%

Percentage of Students Taking Precalculus as Their First College Math Course Who Were Recommended to College Algebra

1995–96	47%
1996–96	33%
1997–98	17%
1998–99	7%

TABLE 14

A Comparison of the Calculus I Grade Distributions Over Fall 1995–Spring 1999 of Students Who Were Recommended or Provisionally Recommended to Precalculus or Recommended to College Algebra But Who Went Directly Into Calculus I and Students Who Were Recommeded or Provisionally Recommended to Precalculus or Recommended to College Algebra And Who Completed the Precalculus/Calculus I Sequence With Precalculus Taken Only Once

Grade Distribution of Students Who Were Recommended or Provisionally Recommended to Precalculus or Recommended to College Algebra But Who Went Directly Into Calculus I
Total: 40

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	6	5	10	8	4	7
%:	15	12.5	25	20	10	17.5

Grade Distribution of Students Who Were Recommended or Provisionally Recommended to Precalculus or Recommended to College Algebra And Who Completed the Precalculus/Calculus I Sequence With Precalculus Taken Only Once
Total: 67

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	9	13	25	4	4	12
%:	13.43	19.4	37.31	5.93	5.93	17.9

TABLE 15

A Comparison of the Calculus I Grade Distributions Over Fall 1995–Spring 1999 of Students Who Were Recommended to College Algebra But Who Went Directly Into Calculus I and Students Who Were Recommended to College Algebra And Who Completed the Precalculus/Calculus I Sequence With Precalculus Taken Only Once

Grade Distribution of Students Who Were Recommended to College Algebra But Who Went Directly Into Calculus I
Total: 4

Grade:	A	B	C	D	F	W
Number:	0	1	1	1	1	0
%:	0	25	25	25	25	0

Grade Distribution of Students Who Were Recommended to College Algebra And Who Completed the Precalculus/Calculus I Sequence With Precalculus Taken Only Once
Total: 18

Grade:	A	B	C	D	F	W
Number:	0	2	5	1	2	8
%:	0	11.11	27.78	5.56	11.11	44.44

TABLE 16

A Comparison of the Calculus I Grade Distributions Over Fall 1995–Spring 1999 of Students Who Were Recommended or Provisionally Recommended to Precalculus But Who Went Directly Into Calculus I and Students Who Were Recommended or Provisionally Recommended to Precalculus And Who Completed the Precalculus/Calculus I Sequence With Precalculus Taken Only Once

Grade Distribution of Students Who Were Recommended or Provisionally Recommended to Precalculus But Who Went Directly Into Calculus I
Total: 36

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	6	4	9	7	3	7
%:	16.67	11.11	25	19.44	8.34	19.44

Grade Distribution of Students Who Were Recommended or Provisionally Recommended to Precalculus And Who Completed the Precalculus/Calculus I Sequence With Precalculus Taken Only Once
Total: 49

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	9	11	20	3	2	4
%:	18.37	22.45	40.82	6.12	4.08	8.16

TABLE 17

A Comparison of the Precalculus Grade Distributions Over Fall 1995–Spring 1999 of Students Who Were Recommended to College Algebra But Who Went Directly Into Precalculus and Students Who Were Recommended to College Algebra And Who Completed the College Algebra/Precalculus Sequence With College Algebra Taken Only Once

Grade Distribution of Students Who Were Recommended to College Algebra But Who Went Directly Into Precalculus
Total: 89

Grade:	A	B	C	D	F	W
Number:	3	17	35	11	4	19
%:	3.36	19.1	39.33	12.36	4.5	21.35

Grade Distribution of Students Who Were Recommended to College Algebra And Who Completed the College Algebra/Precalculus Sequence With College Algebra Taken Only Once
Total: 89

Grade:	A	B	C	D	F	W
Number:	12	18	37	10	6	6
%:	13.48	20.22	41.57	11.23	6.75	6.75

TABLE 18

A Comparison of the Precalculus Grade Distributions Over Fall 1995–Spring 1999 of Students Who Were Recommended to College Algebra With an ACT Math Score of 21 or Above But Who Went Directly Into Precalculus and Students Who Were Recommended to College Algebra With an ACT Math Score of 21 or Above And Who Completed the College Algebra/Precalculus Sequence With College Algebra Taken Only Once

Grade Distribution of Students Who Were Recommended to College Algebra With an ACT Math Score of 21 or Above But Who Went Directly Into Precalculus
Total: 45

Grade:	A	B	C	D	F	W
Number:	1	14	18	6	2	4
%:	2.26	31.1	40	13.33	4.44	8.88

Grade Distribution of Students Who Were Recommended to College Algebra With an ACT Math Score of 21 or Above And Who Completed the College Algebra/Precalculus Sequence With College Algebra Taken Only Once
Total: 40

Grade:	A	B	C	D	F	W
Number:	7	10	18	1	3	1
%:	17.5	25	45	7.5	7.5	2.5

TABLE 19

A Comparison of the Precalculus Grade Distributions Over Fall 1995–Spring 1999 of Students Who Were Recommended to College Algebra With an ACT Math Score of 20 or Below But Who Went Directly Into Precalculus and Students Who Were Recommended to College Algebra With an ACT Math Score of 20 or Below And Who Completed the College Algebra/Precalculus Sequence With College Algebra Taken Only Once

Grade Distribution of Students Who Were Recommended to College Algebra With an ACT Math Score of 20 or Below But Who Went Directly Into Precalculus
Total: 40

Grade:	A	B	C	D	F	W
Number:	2	3	14	5	2	14
%:	5	7.5	35	11	12.5	35

Grade Distribution of Students Who Were Recommended to College Algebra With an ACT Math Score of 20 or Below And Who Completed the College Algebra/Precalculus Sequence With College Algebra Taken Only Once
Total: 49

Grade:	A	B	C	D	F	W
Number:	5	8	19	9	3	0
%:	10.2	16.32	38.78	18.38	6.12	10.2

TABLE 20

Grade Distributions Over Fall 1996–Spring 1999 For Calculus I For Groups I, II, and III

Group I: Grade Distribution of Students Taking Calculus I as Their First College Math Course
Total: 80

Grade:	A	B	C	D	F	W
Number:	24	19	19	9	5	4
%:	30	23.75	23.75	11.25	6.25	5

Group II: Grade Distribution of Students Taking Calculus I for the First Time
Total: 161

Grade:	A	B	C	D	F	W
Number:	36	36	48	14	9	18
%:	22.36	22.36	29.81	8.7	5.6	11.18

Group III: Grade Distribution of All Students Taking Calculus I
Total: 180

Grade:	A	B	C	D	F	W
Number:	38	40	54	33	15	20
%:	21.11	22.22	30.56	8.33	6.66	11.11

TABLE 21

Grade Distributions Over Fall 1996–Spring 1999 For Precalculus For Groups I, II, and III

Group I: Grade Distribution of Students Taking Precalculus as Their First College Math Course
Total: 226

Grade:	A	B	C	D	F	W
Number:	64	77	46	15	7	17
%:	28.32	34.07	20.35	6.64	3.1	7.52

Group II: Grade Distribution of Students Taking Precalculus for the First Time
Total: 394

Grade:	A	B	C	D	F	W
Number:	89	107	107	34	20	37
%:	22.59	27.16	27.16	8.63	5.07	9.39

Group III: Grade Distribution of All Students Taking Precalculus
Total: 454

Grade:	A	B	C	D	F	W
Number:	91	113	134	44	27	45
%:	20.04	24.89	29.62	9.69	5.95	9.91

TABLE 22

Grade Distributions Over Fall 1996–Spring 1999 For College Algebra For Groups I, II, and III

Group I: Grade Distribution of Students Taking College Algebra as Their First College Math Course
Total: 363

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	40	80	99	51	41	52
%:	11.01	22.04	27.27	14.05	11.3	14.33

Group II: Grade Distribution of Students Taking College Algebra for the First Time
Total: 376

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	42	82	101	52	45	54
%:	11.17	21.81	26.86	13.83	11.97	14.36

Group III: Grade Distribution of All Students Taking College Algebra
Total: 430

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	44	90	121	58	55	62
%:	10.23	20.93	28.14	13.49	12.79	14.42

TABLE 23

Grade Distributions Over the 1996–97 Academic Year For College Algebra For Groups I, II, and III

Group I: Grade Distribution of Students Taking College Algebra as Their First College Math Course
Total: 108

Grade:	A	B	C	D	F	W
Number:	8	10	23	15	13	39
%:	7.41	9.26	21.3	13.89	12.04	36.11

Group II: Grade Distribution of Students Taking College Algebra for the First Time
Total: 110

Grade:	A	B	C	D	F	W
Number:	8	10	23	15	14	40
%:	7.27	9.09	20.9	13.64	12.73	36.36

Group III: Grade Distribution of All Students Taking College Algebra
Total: 125

Grade:	A	B	C	D	F	W
Number:	8	11	28	16	17	45
%:	6.4	8.8	22.4	12.8	13.6	36

TABLE 24

Grade Distributions Over the 1997–98 Academic Year For College Algebra For Groups I, II, and III

Group I: Grade Distribution of Students Taking College Algebra as Their First College Math Course
Total: 132

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	16	38	32	17	20	9
%:	7.41	29.79	24.24	12.88	15.15	6.28

Group II: Grade Distribution of Students Taking College Algebra for the First Time
Total: 136

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	16	39	33	17	21	10
%:	11.76	28.68	24.26	12.5	15.49	7.35

Group III: Grade Distribution of All Students Taking College Algebra
Total: 163

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	18	45	45	20	23	12
%:	11.04	27.61	27.61	12.27	14.11	7.36

TABLE 25

Grade Distributions Over the 1998–99 Academic Year For College Algebra For Groups I, II, and III

Group I: Grade Distribution of Students Taking College Algebra as Their First College Math Course
Total: 123

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	16	32	44	19	8	4
%:	13.01	26.02	35.77	15.45	6.5	3.25

Group II: Grade Distribution of Students Taking College Algebra for the First Time
Total: 130

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	18	33	45	20	10	4
%:	13.85	25.38	34.62	15.38	7.69	3.08

Group III: Grade Distribution of All Students Taking College Algebra
Total: 142

Grade:	**A**	**B**	**C**	**D**	**F**	**W**
Number:	18	34	48	22	15	5
%:	12.68	23.94	33.8	15.49	10.56	3.53

TABLE 26

A Comparison of the Performance of Students in the Second Course of a Two-course Sequence Versus Their Performance in the First Course of the Sequence, Over Fall 1993–Spring 1999

Distribution of Calculus I Grades Versus Precalculus Grades For Students Who Completed the Precalculus/Calculus I Sequence With Precalculus Taken Only Once, During Fall 1993 or Later

	Calculus I Grade						
Precalc Grade	A	B	C	D	F	W	Total
A	12	16	10	0	1	1	40
B	1	4	22	4	2	8	41
C	0	0	5	7	2	10	24

Distribution of Precalculus Grades Versus College Algebra Grades For Students Who Completed the College Algebra/Precalculus Sequence With College Algebra Taken Only Once, During Fall 1993 or Later

	Precalculus Grade						
Coll Algebra Grade	A	B	C	D	F	W	Total
A	10	5	2	0	1	0	18
B	3	10	25	6	2	4	50
C	1	8	30	8	4	8	59

TABLE 27

Selected Grade Distributions Over Fall 1995–Spring 1999 For Students With An MPT Score of 21 or 22 and an ACT Math Score of 28 or Above

Precalculus Grade Distribution of Students Who Took Precalculus As Their First College Math Course
Total: 8

Grade:	A	B	C	D	F	W
Number:	4	4	0	0	0	0
%:	50	50	0	0	0	0

Calculus I Grade Distribution of Students Who Completed the Precalculus/Calculus I Sequence With Precalculus As Their First College Math Course
Total: 2

Grade:	A	B	C	D	F	W
Number:	1	0	1	0	0	0
%:	50	0	50	0	0	0

Calculus I Grade Distribution of Students Who Took Calculus I As Their First College Math Course
Total: 7

Grade:	A	B	C	D	F	W
Number:	2	3	0	0	0	2
%:	28.5	43	0	0	0	28.5

TABLE 28

Selected Grade Distributions Over Fall 1995–Spring 1999 For Students With An MPT Score of 21 or 22 and an ACT Math Score From 21 Through 27

Precalculus Grade Distribution of Students Who Took Precalculus As Their First College Math Course
Total: 12

Grade:	A	B	C	D	F	W
Number:	7	3	2	0	0	0
%:	58.33	25	16.67	0	0	0

Calculus I Grade Distribution of Students Who Completed the Precalculus/Calculus I Sequence With Precalculus As Their First College Math Course
Total: 3

Grade:	A	B	C	D	F	W
Number:	0	2	1	0	0	0
%:	0	66.67	33.33	0	0	0

Calculus I Grade Distribution of Students Who Took Calculus I As Their First College Math Course
Total: 6

Grade:	A	B	C	D	F	W
Number:	2	2	0	0	1	1
%:	33.33	33.33	0	0	16.67	16.67

TABLE 29

Selected Grade Distributions Over Fall 1995–Spring 1999 For Students With An MPT Score From 9 Through 12 and an ACT Math Score of 25 or Above

College Algebra Grade Distribution of Students Who Took College Algebra As Their First College Math Course
Total: 6

Grade:	A	B	C	D	F	W
Number:	1	3	1	0	1	0
%:	16.67	50	16.67	0	16.67	0

Precalculus Grade Distribution of Students Who Completed the College Algebra/Precalculus Sequence With College Algebra As Their First College Math Course
Total: 2

Grade:	A	B	C	D	F	W
Number:	0	1	1	0	0	0
%:	0	50	50	0	0	0

Precalculus Grade Distribution of Students Who Took Precalculus As Their First College Math Course
Total: 20

Grade:	A	B	C	D	F	W
Number:	6	11	2	0	0	1
%:	30	50	10	0	0	5

TABLE 30

Selected Grade Distributions Over Fall 1995–Spring 1999 For Students With An MPT Score of 11 or 12 and an ACT Math Score From 21 Through 24

College Algebra Grade Distribution of Students Who Took College Algebra As Their First College Math Course
Total: 20

Grade:	A	B	C	D	F	W
Number:	4	9	4	2	1	0
%:	20	45	20	10	5	0

Precalculus Grade Distribution of Students Who Completed the College Algebra/Precalculus Sequence With College Algebra As Their First College Math Course
Total: 10

Grade:	A	B	C	D	F	W
Number:	0	3	5	0	2	0
%:	0	30	50	0	20	0

Precalculus Grade Distribution of Students Who Took Precalculus As Their First College Math Course
Total: 15

Grade:	A	B	C	D	F	W
Number:	1	2	8	3	0	1
%:	6.67	13.33	53.33	0	0	6.67

TABLE 31:
QUICK MATH PLACEMENT FINDER

RECOMMENDED TO CALC I - C
PROVISIONALLY RECOMMENDED TO CALC I - PC
RECOMMENDED TO PRECALC - P
PROVISIONALLY RECOMMENDED TO PRECALC - PP
RECOMMENDED TO COLLEGE ALGEBRA - A

MPT SCORE

ACT MATH SCORE	8 -	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23+
28+	PP	P	P	P	P	P	P	P	P	PC	PC	PC	PC	C	C	C
27	PP	P	P	P	P	P	P	P	P	P	P	P	P	PC	C	C
26	A	P	P	P	P	P	P	P	P	P	P	P	P	PC	C	C
25	A	P	P	P	P	P	P	P	P	P	P	P	P	PC	PC	C
24	A	A	A	PP	PP	P	P	P	P	P	P	P	P	PC	PC	C
23	A	A	A	PP	PP	P	P	P	P	P	P	P	P	PC	PC	C
22	A	A	A	PP	PP	P	P	P	P	P	P	P	P	PC	PC	C
21	A	A	A	PP	PP	P	P	P	P	P	P	P	P	PC	PC	C
20-	A	A	A	A	A	A	A	A	A	PP	PP	PP	PP	P	P	PC

NO ACT MATH SCORE AND MPT SCORE OF: 23 OR ABOVE - RECOMMENDED TO CALCULUS I
13 THROUGH 22 - RECOMMENDED TO PRECALCULUS
12 OR BELOW - RECOMMENDED TO COLLEGE ALGEBRA